

## SOLID STATE IMAGE PICKUP DEVICE

### BACKGROUND OF THE INVENTION

#### Field of the Invention

5           The present invention relates to driving control for a solid state image pickup device.

#### Related Background Art

Conventionally there is known a method for driving a solid state image pickup device as shown in Fig. 1, in which there are shown an image sensor chip 1, a drive timing control device 2 such as a microcomputer (hereinafter called microcomputer) for controlling the image sensor chip 1 by outputting driving pulses therefore, drive mode control wirings 3, drive pulse wirings 5, a reference clock wiring 6, a drive pulse generation circuit 21 provided in the image sensor chip 1, and an image pickup unit/peripheral circuit 22 including plural photoelectric converting elements etc. and a peripheral circuit including horizontal and vertical scanning circuits.

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Fig. 2 shows another conventional configuration, wherein shown are an image sensor chip 1 including the image pickup unit/peripheral circuit 22 shown in Fig. 3 a drive pulse generation circuit 4, drive pulse wirings 5. The drive pulse generation circuit 4 is not integrated in an image sensor chip. In Fig. 2, the microcomputer 2, the drive mode control wirings 3 and

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the reference clock wiring 6 are same as those in Fig. 1.

In the configuration shown in Fig. 1, the image sensor for outputting the image signal is operated by driving the image pickup unit and peripheral circuit 22 either directly by the drive mode control wirings 3 and the reference clock wiring 6 or by drive pulses generated in a circuit in the image sensor chip based on the drive mode control wirings 3 and the reference clock wiring 6. The configuration shown in Fig. 2 is employed in case requiring drive pulses of a strong driving force, wherein the required drive pulses are generated by the chip of the drive pulse generation circuit 4, based on the drive mode control wirings 3 and the reference clock wiring 6.

In either case, the operation mode of the image sensor chip 1 and the timing thereof are determined by the drive timing controlling device 2 such as the microcomputer, and the microcomputer 2 has to be operated in order to drive the image sensor chip 1.

However such conventional operation of the image sensor chip solely by the external drive causes a drawback in certain situations.

For example, such drawback occurs in a case where the image sensor chip performs a preliminary operation and a main operation, in which the main operation accesses the required image information, and the

preliminary operation monitors the projection of the required image onto the image sensor chip. In such process, the main operation starts after the necessary image is projected on the image sensor chip in the preliminary operation, but the preliminary operation may continue for a long period during which the microcomputer 2 and the drive pulse generation circuit 4 have to be continuously operated, so that the consumption of the electric power continues even while the access of the required image information does not take place.

#### SUMMARY OF THE INVENTION

The object of the present invention is to provide a solid state image pickup device, capable of saving the electric power consumption.

The above-mentioned object can be attained, according to an aspect of the present invention, by a solid state image pickup device in which a reference clock generation circuit for determining the basic timing of the drive pulses for the image pickup unit is formed in a same semiconductor chip as that of the image pickup unit or the drive pulse generation circuit.

According to an another aspect of the present invention, there is provided a solid state image pickup device comprising an image pickup unit including plural

photoelectric conversion elements, a drive pulse generation circuit for driving the image pickup unit, a reference pulse generation circuit for determining the timing of the drive pulses, a first control circuit for  
5 controlling the operation mode of the drive pulse generation circuit, a second control circuit for controlling the operation mode of the drive pulse generation circuit, and a switch for connecting either the first control circuit or the second control circuit  
10 to the drive pulse generation circuit.

Other objects of the present invention, and the features thereof, will become fully apparent from the following description, which is to be taken in conjunction with the attached drawings.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 and 2 are views showing conventional configurations;

Fig. 3 is a block diagram showing a first  
20 embodiment of the present invention; and

Fig. 4 is a block diagram showing a second embodiment of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

25 In the following there will be given a detailed explanation on the first embodiment of the present invention, with reference to the attached drawings.

Fig. 3 shows a solid state image pickup device constituting the first embodiment, wherein shown a sensor chip 1 constituted, for example, by a sensor unit 30 including an image pickup unit containing photoelectric conversion elements and peripheral circuits containing horizontal and vertical scanning circuits for reading the charges converted from light by the photoelectric conversion elements, and a drive pulse generation circuit 21; a drive timing control device 2 such as a microcomputer (hereinafter called microcomputer) for controlling the sensor chip 1 by outputting the drive pulses of the main operation mode thereof; drive mode control wirings 3 for the main operation mode from the microcomputer 2; a reference clock wiring 6 for the main operation mode; and drive pulse wirings 5.

There are also shown a reference clock generation circuit 7 for the preliminary operation mode; a preliminary operation mode generation circuit 8 for generating a preliminary operation mode clock signal based on the reference clock signal generated by the reference clock generation circuit 7; a switch 9 for selecting either the clock signal from the microcomputer 2 or the clock signal of the reference clock generation circuit 7 and the preliminary operation mode generation circuit 8; and an output line 10 from the microcomputer 2 for selecting the state of

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the switch 9. The voltage on the output line 10 is for example at a low level in case the microcomputer 2 is turned off, whereby the switch 9 selects the outputs of the internal reference clock generation circuit 7 and the preliminary operation mode generation circuit 8, but assumes a high level in case the microcomputer 2 is turned on whereby the switch 9 selects the pulses of the drive mode control wirings 3 and the reference clock wiring 6 from the microcomputer 2 .

10 There are further provided a detection circuit 11 for detecting whether the output of the sensor unit in the preliminary operation mode contains a necessary image signal, and a latch circuit 12 for latching the output of the detection circuit 11, and the output 13

15 of the latch circuit 12 is transmitted to the microcomputer 2. A switch 14 transmits the output of the sensor either to the image detection circuit 11 or the microcomputer. For example the voltage of the output 13 can be selected as high or low respectively

20 when the image pickup unit fetches or not the necessary image. In such situation, the microcomputer 2 in the off state can be turned on by a shift of the output 13 from the low level to the high level, whereby the operation of the image sensor can shift from the

25 preliminary operation under the control of the reference clock generation circuit 7 and the preliminary operation mode generation circuit 8 to the

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main operation under the control of the microcomputer  
2.

The microcomputer 2 can access the necessary image  
information exactly from the sensor output 20 in the  
5 main operation. A drive pulse generation circuit 21  
gives various drive pulses such as drive pulses for  
horizontal scanning, drive pulses for vertical  
scanning, and a reset pulse for the image pickup unit  
etc., to the sensor unit.

10 In the following there will be explained the  
operation of the present embodiment.

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At first, in the preliminary operation mode, the  
clock pulses from the preliminary operation mode  
generation circuit and from the reference clock  
15 generation circuit are input, respectively through the  
switches 9-1, 9-2 into the drive pulse generation  
circuit. Also the switch 14 switches the sensor output  
into the detection circuit 11.

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Based on the signals from the reference clock  
20 generation circuit and the preliminary operation mode  
generation circuit, the drive pulse generation circuit  
transmits pulses to the horizontal and vertical  
scanning circuits, thereby reading the signals from the  
photoelectric conversion elements of the sensor unit.

25 The signals read from the sensor unit are entered into  
the image detection circuit, and, if the necessary  
image is detected, the output of the latch circuit is

shifted to a high level state whereby the microcomputer is turned on. At the same time the switch 9 is so shifted that the signal from the microcomputer is supplied to the drive pulse generation circuit. Also the switch 14 is so shifted that the sensor output is connected to the microcomputer.

Based on the control signal from the microcomputer, the drive pulse generation circuit sends pulses to the horizontal and vertical scanning circuits, whereby the signals are read from the photoelectric conversion elements of the sensor unit. The signals read from the sensor unit are entered into the microcomputer and subjected to image signal processing such as color processing, white balancing etc. to obtain an image signal.

The above-described embodiment allows to reduce the wasteful power consumption in the microprocessor, by turning off the microcomputer 2 in the preliminary operation because only a simple signal process is executed, and starting the control by the microcomputer in the main operation in which the image information has to be fetched. The preliminary operation reduces power consumption by operating low-resolution readout, and by performing an intermittent operation, for example every 500 ms. Such intermittent operation can be realized by counting the reference clock signals with a counter.



Specifically, in the preliminary operation, the preliminary operation mode generation circuit 8 generates a drive control signal of the preliminary operation mode based on the reference clock signal generated by the reference clock generation circuit 7 on the image sensor chip, and the drive pulse generation circuit 21 generates drive pulses based on the generated drive control signal to drive the peripheral scanning circuits. The image pickup unit sequentially reads out the image signal corresponding to light received in the preliminary operation mode. In the case that the image detection circuit 11 determines that the sensor receives the necessary image, the latch circuit 12 is latched. This determination may be attained by simple image detection, such as detection of an image signal component whose level is greater than a predetermined level. In the preliminary operation, it is therefore possible in a scanning and read-out operation to reduce the number of the horizontal and vertical scanning lines in image signal reading to a half of that in the main operation mode or to perform the operation intermittently, since the sensor is operated as a monitor to merely determine whether or not the sensor receives the necessary image. The power consumption in this case can be significantly reduced not only in the microcomputer but also in the solid state image pickup

device.

In the following there will be given a detailed explanation on the second embodiment of the present invention, with reference to the attached drawings.

5 Fig. 4 shows the second embodiment of the present invention. An image sensor chip 1 is driven by a drive pulse generation chip 4. In Fig. 4, the image sensor chip 1, microcomputer 2, drive mode control pulse 3, drive pulse generation chip 4, drive pulse 5, reference clock pulse 6, reference clock generation circuit 7, operation mode generation circuit 8, switch 9, mode switching selection pulse 10, image detection circuit 11, latch 12, image detection discriminating output 13, drive pulse generation circuit 21, and sensor output 20  
10 in the microcomputer control are same as those shown in Fig. 3 and will not be explained again.

15 In this configuration, though the entire device is composed of the image sensor chip 1 and the drive pulse generation chip 4, the latter is provided therein with the reference clock generation circuit 7, the operation mode generation circuit 8 and the switch 9, so that, in the preliminary operation, the image pickup unit and the peripheral scanning circuit 2 in the image sensor chip 1 are operated in synchronization with the  
20 reference clock signal generated in the reference clock generation circuit 7, thereby outputting the image signal to the sensor output 14.

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Also in the main operation, the reference clock pulse 6 and the drive mode control pulse 3 are supplied to the drive pulse generation circuit 21 according to the reference clock signal in the microcomputer 2 to operate the image pickup unit and the peripheral scanning circuit 22 in the image sensor chip 1, thereby outputting the image signal to the sensor output 14.

10 In the second embodiment shown in Fig. 4, in the preliminary operation, the image sensor chip 1 operates at the timing of the reference clock generation circuit 7 formed in the drive pulse generation chip 4, and the microcomputer 2 remains in the turned-off state.

15 As in the first embodiment, the control is switched to the microcomputer 2 when it is turned on, thereby suppressing the power consumption of the microcomputer 2 in the preliminary operation and also suppressing the power consumption in the entire device.

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20 As explained in the foregoing, the first and second embodiments allow to select the drive mode control for the sensor unit by the external microcomputer or by the reference clock generation circuit and the operation mode generation circuit formed on the image sensor chip or on the drive pulse generation circuit chip, whereby it is rendered possible to suspend the operation of the microcomputer during the preliminary operation mode in which the signal processing by the external microcomputer is not

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required, thereby suppressing the wasteful power consumption in the microcomputer.

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Also in the preliminary operation, further suppression of the power consumption is possible since the image pickup unit and the peripheral scanning circuit can be independently operated on the image sensor chip or the drive pulse generation circuit chip.

10 In the foregoing first and second embodiments, the sensor unit, the reference clock generation circuit, the drive pulse generation circuit etc. are assumed to be integrated into a single chip, but it is also possible to integrate the sensor unit and the reference clock generation circuit only in a chip. It is thus possible to change the combination of the circuits to be integrated in a single chip, or to form such  
15 circuits as separate components.

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20 Many widely different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in the specification, except as defined in the appended claims.